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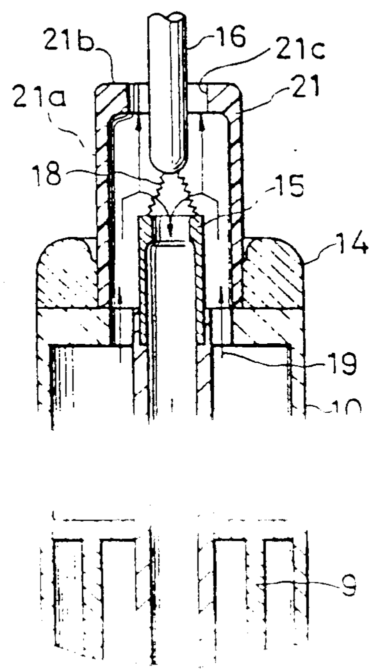
(54) Gas-blast load-break switch.

(57) In a gas-blast load-break switch, a nozzle (21) is configurated so as to have a cylindrical trunk part (21a) and a bottom part(21b); the cylindrical trunk part (21a) has enough large inner diameter to withstand a recovery voltage generated between the fixed arc contact (16) and the movable arc contact (15) in breaking current, and thereby an inner surface of the nozzle (21) is isolated from the arc space, so that undesirable creating discharge on the nozzle (21), flashover through the nozzle (21) or the reignition outside the nozzle (21) is prevented.

FIG.2



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Gas-blast load-break switch

1. FIELD OF THE INVENTION

The present invention relates to such a gas-blast load-break switch wherein an insulation gas extinguishes an arc thereby to break current as a load disconnecting switch or a gas-blast circuit breaker.

2. DESCRIPTION OF THE RELATED ART

FIG. 5 is a cross-sectional view showing the conventional puffer type gas-blast load-break switch disclosed in the Japanese published patent application Sho 53-133771, and FIGs. 6 and 7 are an enlarged partial cross-sectional views of FIG. 5 at the time of current-breaking. In FIG. 5, a fixed side shield 3 which is held by a first insulation spacer 2 is provided inner upper side of a cylindrical gas-tight earthed tank 1. A second insulation spacer 4 which is provided on the middle part of the earthed tank 1 is connected to a movable side shield 6 via a connector 5. The movable side shield 6 is fixed to a supporter 8, which is held by an insulation cylinder 7. A piston 9 which is one member of insulation gas supply unit is fixed on the supporter 8. A cylinder 10 is provided around the piston 9 in a manner slidable thereon in up-down direction of the figure, and a puffer chamber 11 is formed by a space sectioned by the cylinder 10 and the piston 9. A fixed finger 12 whose lower end is fixed to the piston 9 is provided around the cylinder 10, and the cylinder 10 is slidable in the up-down direction against the fixed finger 12. A cylindrical piston rod 13 having a through-passage therein is inserted slidably into the center of the piston 9 and is upwardly projected out of the cylinder 10. The insulation gas supply unit comprises the piston 9, the cylinder 10, the fixed finger 12 and the piston rod 13. The piston rod 13 has a movable arc contact 15 on an upper end thereof for connecting to a fixed arc contact 16 fixed by its upper end to the fixed side shield 3. The movable arc contact 15 is disposed on the same axis as the fixed arc contact 16. A nozzle 17 which is made of an insulating material is screwed into the shield 14, which is fixed on the cylinder 10, in a manner to surround a lower end of the fixed arc contact 16 and the movable arc contact 15 with a given gap inbetween. An inner surface of this nozzle 17 is formed so that arc-extinguishing insulation gas 19 is conducted to arcs 18 which is formed between the fixed arc contact 16 and the movable arc contact 15 at the time of current-breaking.

Next, operations of the above-mentioned puffer type gas-blast load-break switch is described. When this gas-blast load-break switch is to break a load current, for instance to break the load current of a reactor (not shown) from such closed state that an inner surface of the movable arc contact 15 is engaging with an outer surface of the fixed arc contact 16, an insulating rod 20 is lowered therefor. Accompanying with the lowering of the the insulating rod 20, the movable arc contact 15, the nozzle 17 and the cylinder 10 are lowered, respectively. And thereby, the movable arc contact 15 is disconnected from the fixed arc contact 16, and the arcs 18 is formed between the movable arc contact 15 and the fixed arc contact 16. At that time, the insulation gas 19 compressed by the piston 9 is conducted to an inner space of the nozzle 17. And thereafter, the insulation gas 19 branches out into two passages, upwards toward the fixed arc contact 16 and downwards into the central hole of the piston rod 13 as shown in FIG. 6. Thereby, the arcs 18 are extinguished by mainly cooling effect of the insulation gas 19 blasted thereto.

In breaking the current for reactor, at the moment of breaking, a recovery voltage, which has one hundred and dozens micro seconds duration of wave front and has about "2E" (E is the normal negative peak value of voltage to ground) peak voltage, is impressed across the movable arc contact 15 and the fixed arc contact 16. Therefore, though the insulation gas supply unit blasts the insulation gas 19, reignitions are repeated between the movable arc contact 15 and the fixed arc contact 16. And, when insulation between the movable arc contact 15 and the fixed arc contact 16 comes to be able to withstand the recovery voltage corresponded to the aforementioned "2E", interruption of current is completed.

FIG. 8 is a graph showing a relation between an inter-pole distance and a flashover voltage of the conventional gas-blast load-break switch, wherein a curve I which shows the relation between the movable arc contact 15 (FIG. 6) and the fixed arc contact 16 (FIG. 6) is represented at some inter-pole distances by plotting averages of scatterings "A" of the reignition voltages at the time of current-breaking. Another curve II shows a relation of the flashover voltage, which makes flashover hence to form an arc 30 between the fixed side shield 3 outside the nozzle 17 and the shield 14 as shown in FIG. 5, versus the inter-pole distance thereof. Since there are no gas-flows of the insulation gas 19 outside the nozzle 17, once the flashover occurs the arc 30 cannot be extinguished by this gas-blast load-break switch. Therefore, to

avoid such state, the puffer type gas-blast load-break switch is designed so that the curve II has higher flashover voltages than the highest scatterings of those of the curve I, which shows the relation between the inter-pole distance and the flashover voltage inside the nozzle 17, at the same inter-pole distances.

However, in the above-mentioned conventional puffer type gas-blast load-break switch, when the reignition occurs as shown in FIG. 7, such disposition that an inner surface of the nozzle 17 comes close to an arc space between the fixed arc contact 16 and the movable arc contact 15 brings an undesirable creeping discharge (flashover) 31 along the inner surface of the nozzle 17, and a tracking which brings deterioration of insulation is made thereon. Once the tracking is made on the nozzle 17, the scatterings "A" of the flashover voltage in the curve I of FIG. 8 become large, and thereby the flashover voltages represented by the curve II comes within the region of the scatterings "A" of the curve I. Then the flashover (making the arc 30 of FIG. 5) occurs with a certain probability, and thereby inducing such state that the current cannot be interrupted. Furthermore, as shown in FIG. 7, since the nozzle 17 is exposed in a high potential field, a flashover (making an arc 32) through the nozzle 17 occurs between the fixed arc contact 16 and the shield 14. And thereby, the arc 18 flows to the shield 14 which is disposed apart from gas-flows of the insulation gas 19, thereby inducing such state that the current cannot be interrupted.

OBJECT AND SUMMARY OF THE INVENTION

The object of the present invention is to offer an improved gas-blast load-break switch which is capable of preventing the creeping discharge on the nozzle, flashover through the nozzle and the reignition outside the nozzle thereby achieving an excellent breaking ability.

In order to achieve the above-mentioned object, a gas-tight load-break switch in accordance with present invention comprises:

a gas-tight tank,

a fixed arc contact fixed in the tank,

a movable arc contact which is held in the tank movable on the same axis as an axis of the fixed

... blasting an insulation gas ...

is formed by disconnecting the fixed arc contact from the movable arc contact, and

a nozzle which is held in the tank for conducting

trunk part having a larger inner diameter to withstand a recovery voltage generated between the fixed arc contact and the movable arc contact in breaking current and a bottom part having a hole of smaller inner diameter for surrounding the fixed arc contact, thereby to isolate an inner surface of the nozzle from an arc space between the fixed arc contact and the movable arc contact.

By adopting the above-mentioned construction, the inner surface of the nozzle is isolated from the arc space formed between the fixed arc contact and the movable arc contact. Thereby, the creeping discharge on the nozzle, flashover through the nozzle or the reignition outside the nozzle is prevented, and thereby the breaking ability can be improved.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a cross-sectional view showing an embodiment of a puffer type gas-blast load-break switch in accordance with the present invention.

FIG. 2 is an enlarged partial cross-sectional view of FIG. 1 at the time of current breaking.

FIG. 3 is an enlarged partial cross-sectional view of FIG. 1 after breaking current.

FIG. 4 is a graph showing relations between inter-pole distance and flashover voltage of the embodiment shown in FIG. 1.

FIG. 5 is the cross-sectional view showing the conventional puffer type gas-blast load-break switch.

FIG. 6 is the enlarged partial cross-sectional view of FIG. 5 at the time of current-breaking.

FIG. 7 is the partial enlarged cross-sectional view of FIG. 5 showing undesirable state of current-breaking.

FIG. 8 is the graph showing relations between inter-pole distance and flashover voltage of the conventional puffer type gas-blast load-break switch shown in FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, preferred embodiment of the present invention is described with reference to the accompanying drawings.

breaking and after breaking current, respectively. In FIG. 1, a fixed side shield 3 which is held by a first insulation spacer 2 is provided inner upper side of

insulation spacer 4 which is provided on the middle part of the earthed tank 1 is connected to a movable side shield 6 via a connector 5. The movable side shield 6 is fixed to a supporter 8, which is held by an insulation cylinder 7. A piston 9 which is one member of insulation gas supply unit is fixed on the supporter 8. A cylinder 10 is provided around the piston 9 in a manner slidable thereon in up-down direction of the figure, and a puffer chamber 11 is formed by a space sectioned by the cylinder 10 and the piston 9. A fixed finger 12 whose lower end is fixed to the piston 9 is provided around the cylinder 10, and the cylinder 10 is slidable in the up-down direction against the fixed finger 12. A cylindrical piston rod 13 having a through-passage therein is inserted slidably into the center of the piston 9 and is upwardly projected out of the cylinder 10. The insulation gas supply unit comprises the piston 9, the cylinder 10, the fixed finger 12 and the piston rod 13. The piston rod 13 has a movable arc contact 15 on an upper end thereof for connecting to a fixed arc contact 16 fixed by its upper end to the fixed side shield 3. The movable arc contact 15 is disposed on the same axis as the fixed arc contact 16. A nozzle 21 which is made of an insulating material is screwed into the shield 14, which is fixed on the cylinder 10, in a manner to surround a lower end of the fixed arc contact 16 and the movable arc contact 15 with a given gap inbetween. An inner surface of this nozzle 21 is formed so that arc-extinguishing insulation gas 19 is conducted to arcs 18 which is formed between the fixed arc contact 16 and the movable arc contact 15 at the time of current-breaking.

Next, operations of the above-mentioned puffer type gas-blast load-break switch embodying the present invention is described. When this gas-blast load-break switch is to break a load current, for instance to break the load current of a reactor (not shown) from such closed state that an inner surface of the movable arc contact 15 is engaging with an outer surface of the fixed arc contact 16, an insulating rod 20 is lowered therefor. Accompanying with the lowering of the insulating rod 20, the movable arc contact 15, the nozzle 21 and the cylinder 10 are lowered, respectively. And thereby, the movable arc contact 15 is disconnected from the fixed arc contact 16, and the arcs 18 is formed between the movable arc contact 15 and the fixed arc contact 16. At that time, the insulation gas 19 compressed by the piston 9 is conducted to an inner space of the nozzle 21. And thereafter, the insulation gas 19 branches out into two passages, upwards toward the fixed arc contact 16 and downwards into the central hole of the piston rod 13 as shown in FIG. 2. Thereby, the arcs 18 are extinguished by mainly cooling effect of the insulation gas 19 blasted thereto.

In breaking the current for reactor, at the moment of breaking, a recovery voltage, which has one hundred and dozens micro seconds duration of wave front and has about "2E" (E is the normal negative peak value of voltage to ground) peak voltage, is impressed across the movable arc contact 15 and the fixed arc contact 16. Therefore, though the insulation gas supply unit blasts the insulation gas 19, reignitions are repeated between the movable arc contact 15 and the fixed arc contact 16. And, when insulation between the movable arc contact 15 and the fixed arc contact 16 comes to be able to withstand the recovery voltage corresponded to the aforementioned "2E", interruption of current is completed.

Hereupon, as shown in FIG. 2, the nozzle 21 has a cylindrical trunk part 21a and a bottom part 21b having a hole 21c thereon. An inner diameter of the cylindrical trunk part 21a is formed large up to a predetermined position so that the inner surface of the nozzle 21 can withstand an electric field of recovery voltage at the time of current-breaking between the fixed arc contact 16 and the movable arc contact 15, and an inner diameter of the hole 21c in the bottom part 21b is formed smaller than that of the cylindrical trunk part 21a in order to surround the fixed arc contact 16. And thereby, the inner surface of the nozzle 21 is sufficiently isolated from an arc space between the fixed arc contact 16 and the movable arc contact 15.

In the above-mentioned puffer type gas-blast load-break switch, as shown in FIG. 2, since the inner surface of the nozzle 21 is isolated from the above-mentioned arc space at the time of current-breaking for the reactor, the arcs 18 is formed only between the fixed arc contact 16 and the movable arc contact 15. After that, as shown in FIG. 3, an inter-pole distance "a" withstands the recovery voltage, and thereby interruption of current is completed.

FIG.4 is a graph showing a relation between inter-pole distance and flashover voltage of the embodiment, wherein a curve I which shows the relation between the movable arc contact 15 (FIG. 2) and the fixed arc contact 16 (FIG. 2) is represented at some inter-pole distances by plotting averages of scatterings "B" of the reignition voltages at the time of current-breaking. Another curve II shows a relation of the flashover voltage, which makes flashover hence to form an arc 30 between the fixed side shield 3 outside the nozzle 17 and the shield 14 as shown in FIG. 1, versus the inter-pole distance thereof.

In comparison with FIG. 8 which shows the conventional relation between the inter-pole distance and the flashover voltage, FIG. 4 of the present invention clarifies that the scatterings "B" of the reignition voltages is smaller than the scat-

terings "A" of FIG. 8. Therefore, the maximum reignition voltage included in the maximum value of the scatterings "B" does not come above the curve II. That is, the reignitions occur only between the fixed arc contact 16 (FIG. 2) and the movable arc contact 15 (FIG. 2). In other words, no reignition occurs outside the nozzle 21 (FIG. 1) between the fixed side shield 3 (FIG. 1) and the shield 14 (FIG. 1).

While specific embodiments of the invention have been illustrated and described herein, it is realized that other modifications and changes will occur to those skilled in the art. It is therefore to be understood that the appended claims are intended to cover all modifications and changes as fall within the true spirit and scope of the invention.

Claims

1. A gas-blast load-break switch comprising:
a gas-tight tank,
a fixed arc contact fixed in said tank,
a movable arc contact which is held in said tank movable on the same axis as an axis of said fixed arc contact for connecting/disconnecting with said fixed arc contact,
insulation gas supply means which is held in said tank for blasting an insulation gas to an arc which is formed by disconnecting said fixed arc contact from said movable arc contact, and
a nozzle which is held in said tank for conducting said insulation gas and is formed by a cylindrical trunk part having a larger inner diameter to withstand a recovery voltage generated between said fixed arc contact and said movable arc contact in breaking current and a bottom part having a hole of smaller inner diameter for surrounding said fixed arc contact, thereby to isolate an inner surface of the nozzle from an arc space between said fixed arc contact and said movable arc contact.

2. A gas-blast load-break switch in accordance with claim 1, wherein
said nozzle is made of an insulating material.

3. A gas-blast load-break switch in accordance with claim 1, wherein
said nozzle is coaxially disposed to said axis and slides on said axis together with said movable arc contact.

4. A gas-blast load-break switch in accordance

FIG. 1

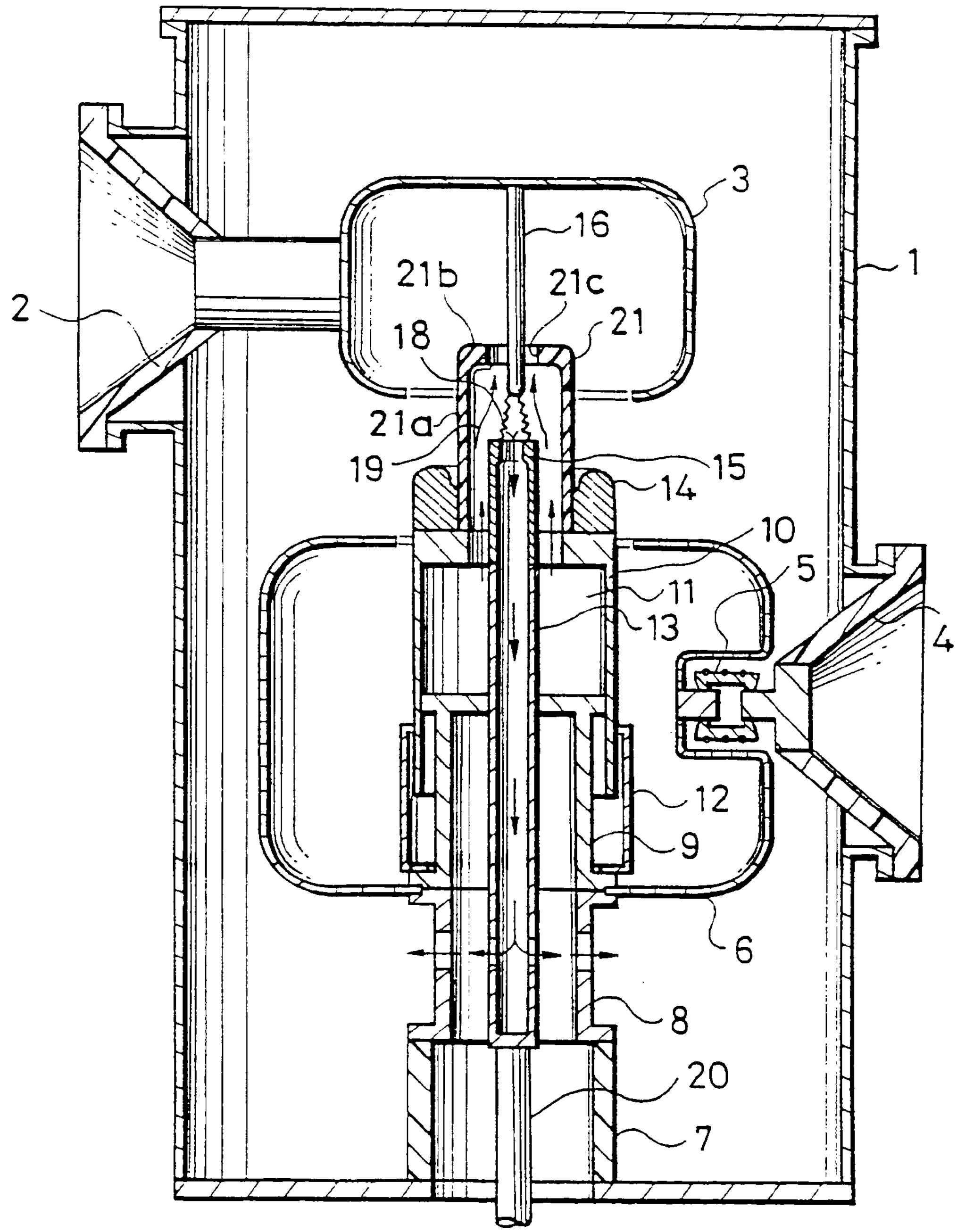


FIG.2

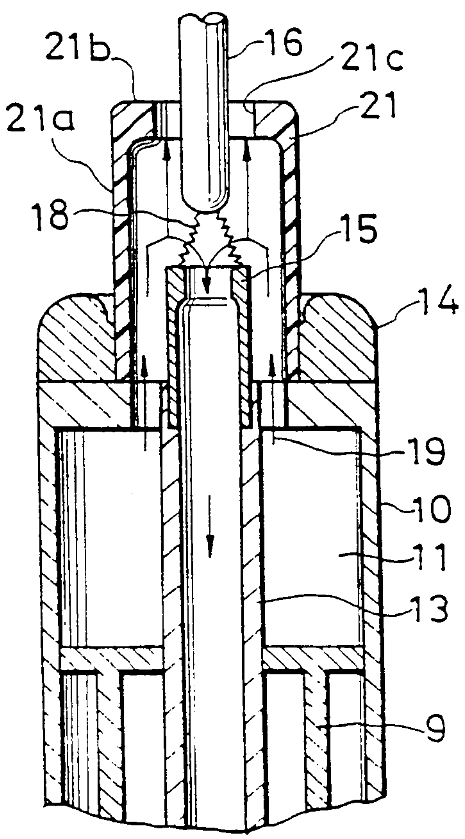

21b
16
21c
21a
21
18
15
14
19
10
11
13
9

FIG.3

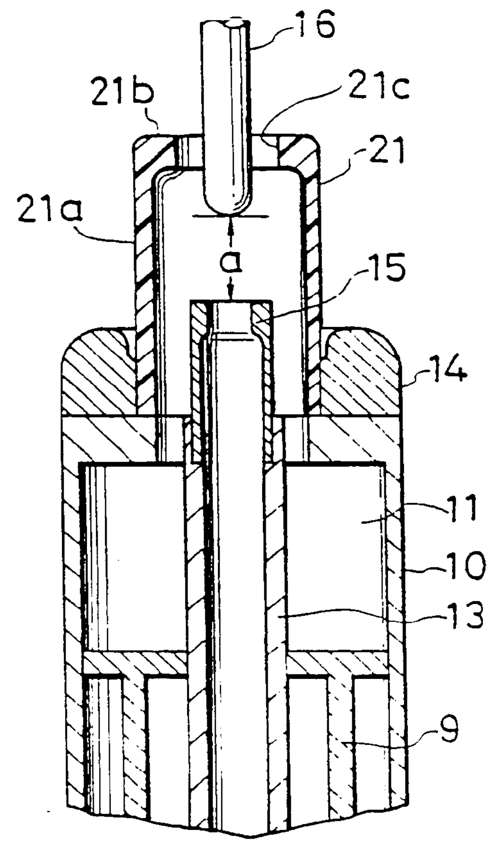

16
21b
21c
21
21a
a
15
14
11
10
13
9

FIG. 4

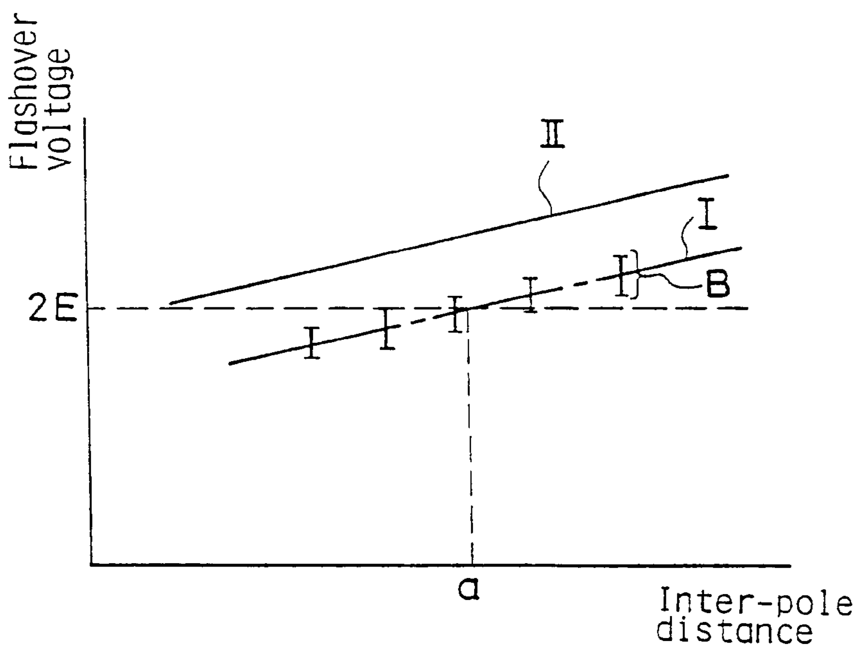


FIG. 5 (Prior Art)

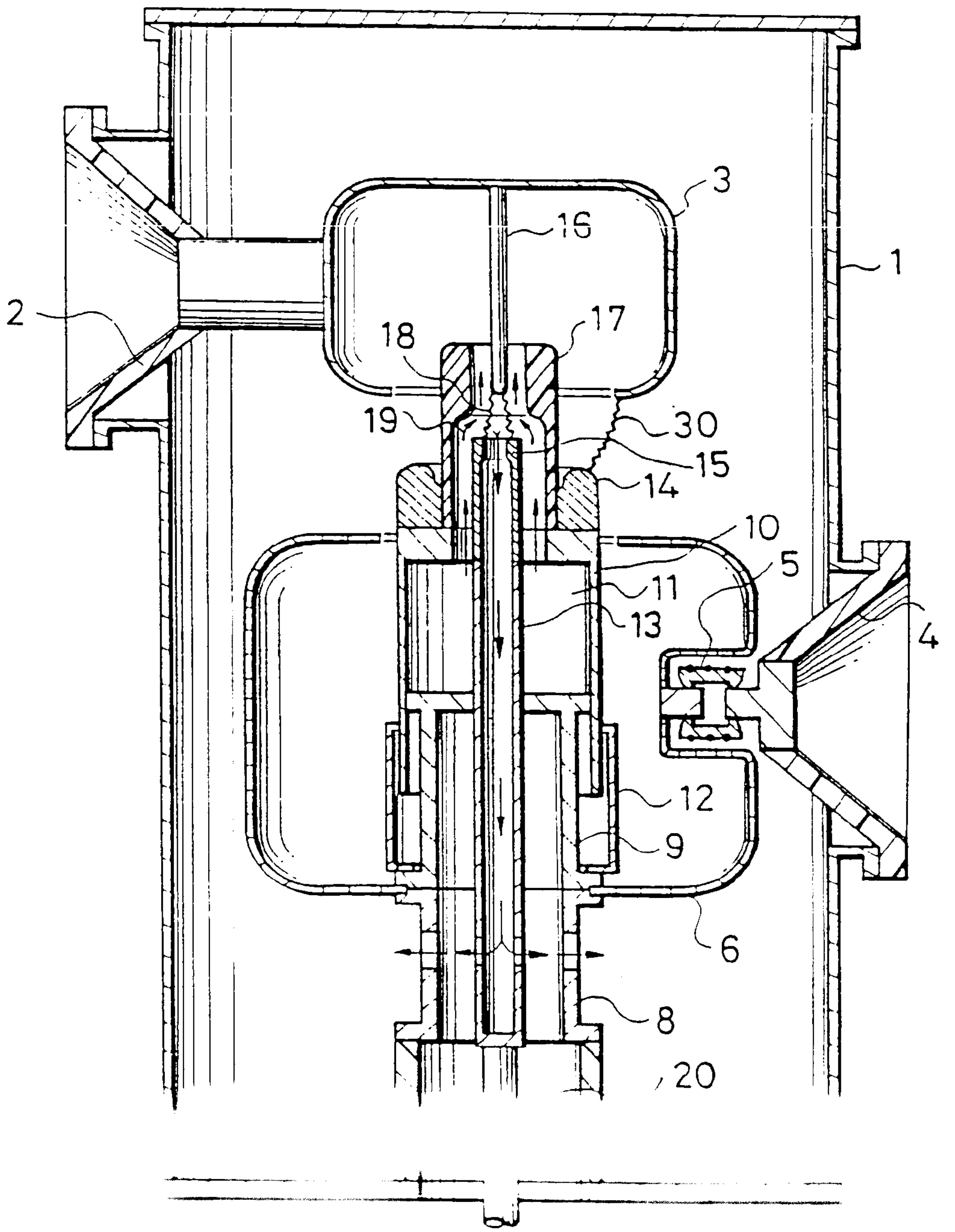


FIG.6
(Prior Art)

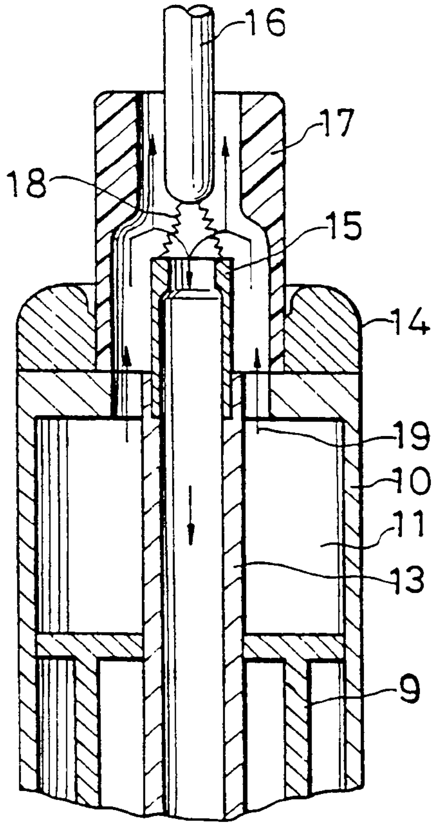


FIG.7
(Prior Art)

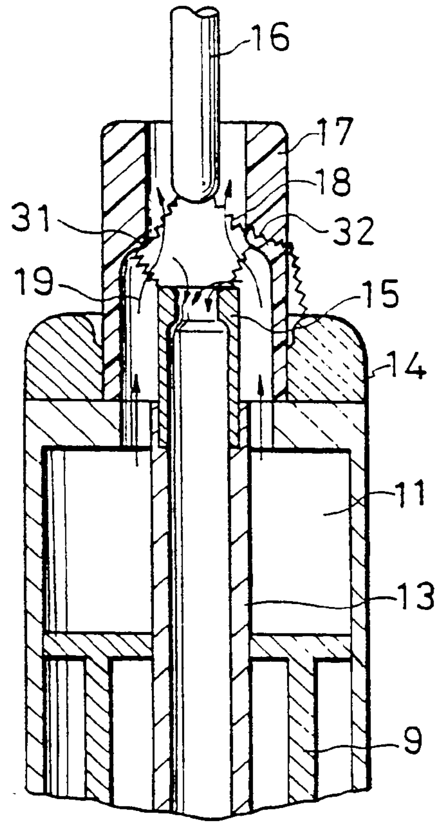
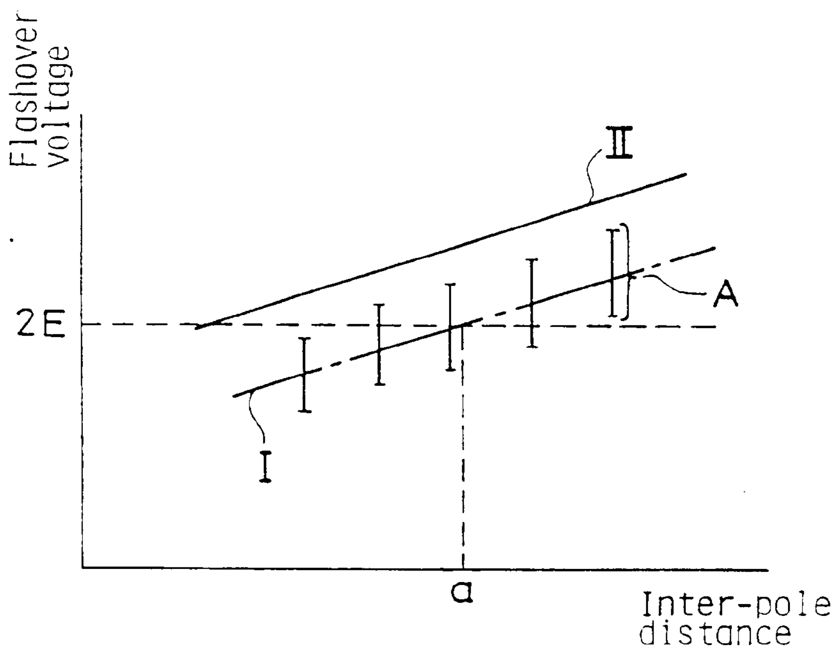


FIG 8 (Prior Art)



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EUROPEAN SEARCH REPORT

Application Number

EP 88 10 2478

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-2 943 386 (TOKIO SHIBAURA) * claims 1,2; page 10, lines 1-4; figures 2,6 *	1-4	H 01 H 33/74
X	US-A-4 256 940 (M. KII) * column 2, lines 48-58; figures 1-4 *	1-4	
X	FR-E- 49 205 (MERLIN ET GERIN) * page 1, line 40 - page 2, line 4; figure 1 *	1-3	
A	FR-A-1 322 238 (ACEC) * whole document *	1-4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			H 01 H 33/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	21-06-1988	DIOU J.M.

CATEGORY OF CITED DOCUMENTS

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